

Ecosystem Services Case Study: The Mississippi River Floods of 1993 and 2008 *Nature’s Flood Regulation Services, Ecosystem Degradation, and the Economic Impacts of Large-Scale Flood Damage*

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Introduction:

The Mississippi River floods of 1993 and 2008 were two of the costliest natural disasters in U.S. history (\$16+ billion for 1993, still being calculated for 2008 but some early estimates are in the range of \$9 billion); subsequent ecological analysis after the 1993 flood revealed that the economic damage was largely driven by land use choices and degradation of the flood regulation services provided by the Mississippi’s surrounding wetlands ecosystems – and that restoration of the original wetlands habitats (with the corresponding renovation of the flood regulation ecosystem service) could significantly contribute to avoiding economic and societal losses if a flood of this magnitude were to happen again.



A few of these ecological & land use planning recommendations were enacted in selected cities before the 2008 flood and were credited for reducing the ultimate impact of the 2008 flood (estimated \$304 million damage savings¹).

This case study will review the complex and intertwining economic impacts caused by these wide-ranging natural disasters, and will also provide an overview of how the restoration of the Mississippi’s surrounding wetlands ecosystems could insulate the region from many of the losses caused by floods of this magnitude.

¹ FEMA estimate via Economic Benefits Report: Preventing Flood Damage, The Trust for Public Land, cited 2/14/2009

Economic Impacts - The Winners:

While the overall impact of a large-scale flood is usually negative (especially when psychological/morale damage to the affected communities is taken into account), there are often pockets of winners and economic bright spots:

- Farmers: In general, farmers outside the flood area (and farmers on high ground within flooded areas) garner high prices due to price pressures caused by the flood.
- Trade exchanges (grain futures & options) typically see a higher than normal volume of trading.
- Agricultural chemicals: Heavy rains keep farmers from tilling fields thereby nourishing weeds, and also new broadleaf & grassy weed seeds are spread by floodwaters, creating record demand for herbicides. Fertilizer companies typically have higher than usual demand to replenish nutrients washed from soil.
- Pumping-equipment makers can operate at triple the normal production rate for several weeks to meet demand from the flood zones.
- Lawyers: "The first priority is to keep customers operating... the second job is sorting out the costs²," which includes scrutinizing contracts and possible follow-on litigation, as well as legal efforts as businesses attempt to have federal relief programs work in their favor.
- Local aerial-survey firms typically have a boom as they assist in surveying flood damage.
- Banks in disaster areas typically make more from new lending than is lost from unsecured losses.
- However, even though there are isolated local winners, note that some studies would seem to suggest that large-scale disasters produce a net positive economic gain; these studies typically focus on the dollars invested in replacing damaged capital/infrastructure – however, these studies fail to take into account the drop in productivity, output, and sales while the capital/assets are out of service – the rebuilding does not reflect an actual economic gain in the broad long-term perspective. In most cases the rebuilding merely replaces lost capital stock – meaning that in the long term, the region’s product will not exceed what would have been produced without the disaster. While the immediate burst of economic activity due to rebuilding is quite evident, the losses from the foregone output of interrupted and diminished business activity may go largely undetected because the diminished growth takes place in small amounts spread over many years.³

Economic Impacts - The Losers:

The complete tally of economic losses after a major disaster is difficult to definitively quantify – direct costs are easier to determine, however indirect costs are more difficult to isolate, especially as costs and their associated benefits can be distributed over wide geographic areas and time scales. However, the following incomplete scorecard will begin to paint the picture of the widespread economic impacts of a large scale flood event:

- Farmers: In 1993, hundreds of farmers along long stretches of the Mississippi, the Missouri and several tributaries lost most if not all of their crops to flooding. The USDA estimated the flooded land at 8 million acres, with 12 million more acres being too wet to produce any crop -- for a total area about the size of South Carolina. Also, longer-term damage resulted, with many floodplain farmers on the Missouri and Middle Mississippi Rivers finding their fields ruined – scoured or filled with sediment, sand, driftwood, trees, & other debris.



² Winners as Well as Losers in the Great Flood of '93, Barnaby J. Feder, New York Times, 8/15/1993

³ Assessing the Midwest Floods of 2008 (and 1993), Rick Mattoon, Federal Reserve Bank of Chicago, 7/10/2008

- Grain elevators: From the Mississippi to the eastern edge of the Great Plains, grain elevators, many owned by small operators or cooperatives, suffered losses directly due to flooding, and also elevators that were not directly flooded suffered because they were unable to ship stock already on hand; over the longer term, they are also hurt by smaller harvests.
- Livestock and poultry growers are affected due to higher feed prices. Larger producers are probably better positioned than smaller competitors because large producers have more cost-plus contracts with major customers that allow them to pass on increased expenses.
- Food Processors: In 1993, Archer-Daniels-Midland estimated that the large-scale flooding cost it \$1.5 million a day. The flooding kept 75 percent of its barges tied up and forced rerouting with reduced loadings for many of the remainder. ConAgra's flour mills were flooded at Alton and Chester, Ill., and the company's Montfort meat-packing subsidiary had two plants shut in Iowa for several weeks, with barge operations being idled. Privately held Cargill was reported to have incurred substantial losses mostly because of logistical difficulties – as an example, so many tank cars of high-fructose corn syrup were backlogged in freight yards so long that soft-drink bottlers on the West Coast used sugar instead. A corn-processing plant in Keokuk, Iowa was shut for more than a month because of flooding.⁴
- Rivers and river valleys historically have been major transportation routes (partly to minimize construction & fuel costs), particularly in the area impacted by the 1993 flood. In the Midwest, transcontinental railroads, interstate highways, and other road systems either follow river valleys or cross them. As a result, physical damages to transportation systems created a significant percentage of total flood damages. In addition to direct damages, indirect costs accrued when transportation routes were inundated by floodwaters, and traffic was halted or detoured. A major portion of flood damages to public facilities in 1993 involved roads and bridges.
- These damages ranged from blown culverts and wash-outs on rural roads and city streets to loss of bridges and damages to interstate highways inundated by floodwaters. Road and bridge flooding also caused indirect losses related to increased transportation costs. In extreme cases, detours of 100 miles were required to travel between adjoining communities that had been connected by a bridge. For example, Keokuk, Iowa, was cut off from market areas in Illinois and Missouri for several weeks when the approaches to bridges over the Mississippi and Des Moines rivers were inundated. This resulted in serious economic impacts on local businesses. For example, flooding of the approaches to the bridge over the Mississippi River at Quincy, Illinois for 73 days resulted in an estimated \$30 million in lost business to Quincy merchants alone⁵.
- Barge lines: In 1993, the nation's largest barge operator had more than one-third of its 3,500 barges idled on the Mississippi. The industry as a whole lost \$3 million a day in revenue from the shutdown, according to its trade group. Some operators laid off workers and shut down terminals to cut costs. The Mississippi River was closed to barge traffic for four months beginning in June, leading to a massive shift of grain and coal shipments to north-south-oriented regional railroads. In 2008, river traffic was halted on a 300-mile stretch of the Mississippi River for 26 days. American Commercial Lines (ACL) reported 16,000 idle barge-days in the 2nd quarter of 2008, with a loss of ~\$10,000 per day per tow, a total \$10.6 million loss for ACL, and \$53 million loss for the entire grain barge industry in 2008. 100-plus barges were stranded with grain (headed downstream); cement,



⁴ Winners as Well as Losers in the Great Flood of '93, Barnaby J. Feder, New York Times, 8/15/1993

⁵ Learning From The Mississippi Flood Of 1993: Impacts, Management Issues, And Areas For Research, Gerald E. Galloway Jr., 1995

scrap metal, fertilizer and other products (headed upstream) while shippers waited for the water to drop. Also, sediment deposits dropped by the floodwaters cause obstacles to barge traffic long after the waters recede.

- Railroads: All of the major railroads serving the flooded regions faced losses in the tens of millions of dollars for repairs and higher operating costs. In 1993, the Santa Fe was especially hurt by the 25-day closing of its main line from Chicago to Kansas City, and other big losses were suffered by the Burlington Northern, Union Pacific, Norfolk Southern, and CP Rail of Canada. Miles of closed track meant rerouting or finding alternate forms of transport. Throughout the Midwest, more than 500 miles of track were underwater at some time and some totally washed away, according to the Association of American Railroads. Some railroads had to lay emergency tracks to prevent customers (especially automotive plants) from closing due to their use of just-in-time inventory systems. Flood-produced damages, delays, and costs to most railroads in the Midwest totaled \$480 million, the greatest loss ever experienced by American railroads. In the 2nd quarter of 2008, Union Pacific expected profits to drop by \$25.8 million.
- In 1993, eleven commercial airports were closed at one time or another due to the flooding.
- State Farm received more than 67,000 claims for the 2008 floods.
- As a human catastrophe, the 1993 flood affected parts of nine Midwest states, caused 52 deaths, and left 74,000 people homeless, disrupting 30,000 jobs and day-to-day life for 149,000 households. The Red Cross responded rapidly, providing emergency shelter for 14,500 people and serving 2.5 million meals at a cost of \$30 million. Some among the dislocated population manifested the damage in increased alcohol and drug use, domestic abuse, and other stress-related behaviors. Even after the flood, environmental factors (including floods) remained high on the list of concerns for people in the affected areas.⁶
- Power companies: Several power companies (including Illinois Power, which serves 560,000 customers mainly in central Illinois) had to use more expensive alternatives to transport coal to some generating stations, with one of their six power plants having to switch to natural gas due to disrupted coal supplies.
- Amoco suffered from reduced travel and a wide range of flood-related disruptions during the 1993 flood. Their Peoria plant has automated unloading facilities for barges, however with barge traffic shut down, the plant obtained supplies by rail with greatly increased labor & handling fees.
- Municipal damage: In 1993, Des Moines, Iowa became the largest U.S. city to lose its water supply when its water treatment plant flooded. More than 250,000 people lost drinking water for 12 hot summer days. Water pipes, contaminated by floodwaters carrying sewage and agricultural chemicals, had to be flushed out before the municipal water supply was reconnected. Economic losses in Des Moines totaled approximately \$716 million.
- Tourism-related businesses: The St. Louis arch became a popular destination for folks wanting to view the Mississippi in full flood, but many other tourist destinations suffered. Hannibal, Mo., the birthplace of Mark Twain, had 10 percent of its normal traffic in July. Even Branson, Mo., 200 miles from any significant flooding, saw a major dropoff in visitors. In Iowa's northwestern lake country, boat dealers and clothing shops that cater to tourists began slashing prices on merchandise to end-of-season levels nearly a month ahead of normal. The Mississippi River Parkway Commission estimated that 50,000 guest beds went unfilled each night in Minnesota, Wisconsin, Iowa, Missouri and Illinois.
- General business operating losses include: reduced revenues, destruction of assets, transportation or logistics problems, lower employee productivity due to absence or stress (during the height of the flooding, many businesses pulled their entire staff off the shop floor and assigned them community sandbagging duty), or other disruptions to normal business operation.
- Lost wages (due to either employer shutdown, or having to miss work to attend to household recovery efforts) have a multiplier effect as the wages are removed from circulation in local economies.

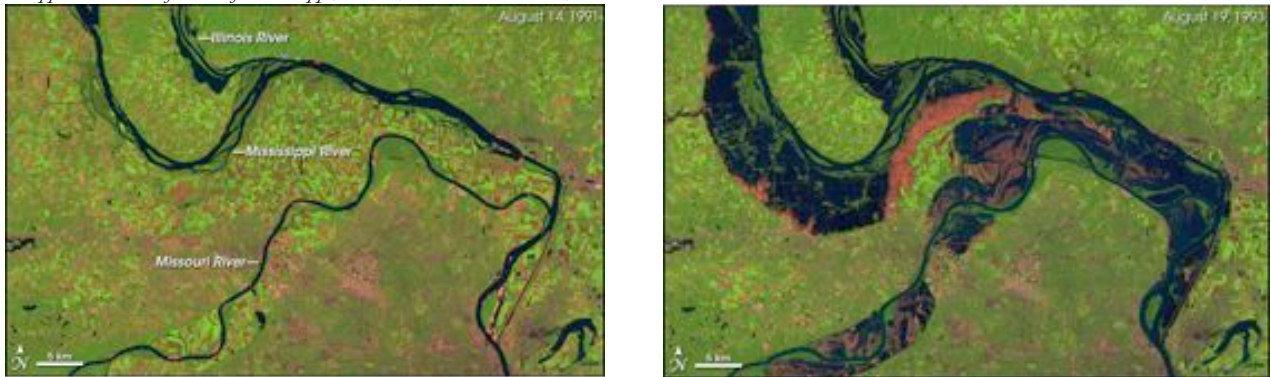
⁶ The Flood of 1993, Charles Theilling, The Ecological Status of the Upper Mississippi River System, Illinois Natural History Survey, 1998

Ecological Analysis and Ecosystem Services Restoration Potential:

A multi-faceted analysis conducted by an interdisciplinary team (led by The University of Missouri-Columbia, The Audubon Society, and The Wetlands Initiative, with participation by dozens of state and federal agencies), determined that the bulk of the flood damage from the 1993 flood was driven by the degradation or outright destruction of the region’s native riparian & wetlands ecosystems, and if those ecosystems had remained intact, the full volume of the floodwaters could have been contained/regulated by the ecosystem with minimal impacts to industry & society:

- To truly solve the ecological problems facing the Upper Mississippi River Basin in five states—Iowa, Illinois, Minnesota, Missouri, and Wisconsin—an ecological solution is required. Despite a century of massive capital investment in flood control structures across the 18 million acres of flood zone, flood damages have increased.
- In addition, the region faces degraded wildlife habitat and water quality due to sediment and nutrient contamination as a result of wetland loss.

Mississippi River at confluence of Mississippi, Illinois, and Missouri rivers; 1991 vs. 1993:



- The proposed ecological solution is to restore natural hydrological functions by reconnecting some of the leveed floodplains to the parent river. Where lands are frequently flooded, economic activities adversely affected by inundation need to be eliminated. In short, the bottomlands of the Upper Mississippi River Basin should be returned to their natural state, which would hold floodwaters for weeks, if not months, at a time, rather than the hours, or at most, days, given the current conditions. A 1993 study by the Illinois State Water Survey found that for every 1 percent increase in protected wetlands along a stream corridor, peak stream flows decrease by 3.7 percent.
- Landscape analysis: First, landscape ecologists identified 1.9 million acres in the 100-year flood zone that could readily be used to store floodwaters. These areas are either behind existing levees (able to store water 10 feet deep) or on existing or drained wetlands outside of levees (able to store water 3 feet deep). Together, these areas could hold 9.6 million acre-feet (one acre covered by a foot of water) of floodwaters. Secondly, ecologists sought to find the best opportunities for wetland restoration within these flood storage areas by identifying areas (totaling 740,000 acres) that are drained wetlands currently used for row crops. The areas identified for restoration have the ability to contain all of the water present in the 1993 flood, with room to spare. The approximate volume of water in the 1993 flood was 39 million acre-feet of water - a minimal ecological restoration could contain 40 million acre-feet of water, while a more comprehensive ecological restoration could contain 72+ million acre-feet of water (nearly double the amount in the 1993 flood)⁷.

⁷ Flood Damage Reduction in the Upper Mississippi River Basin: An Ecological Means, The Wetlands Initiative, 2004

- Economic analysis: An agricultural economist calculated the annual social costs and benefits of converting all cropland in the 100-year flood zone (1.8 million acres) to wetland. Results of the benefit-cost analysis show that cropland conversion is socially efficient for all counties in the study area except for St. Louis County, Missouri. The estimated total annual net benefit of cropland conversion for all sampled counties is \$120.9 million or \$68 per acre. This analysis suggests that society would be better off if cropland acreage in the 100- year flood zone in the study counties was restored to wetlands than if it remained as cropland.
- Bird species (indicators of biodiversity and overall habitat quality): In a third study, Audubon staff assessed how bird diversity would be affected if cropland in the flood zone was converted to wetlands. The numbers are remarkable: 53 species of birds were identified as currently using the cropland on drained wetland in the study counties, whereas Audubon projects that 145 species of birds would be present in the highly diversified restored habitats.

About Landen Consulting

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